University of Malta
G.F. Abela Junior College

FIRST YEAR ADVANCED LEVEL
PRACTICALS TEST

Subject: Physics Practicals

Date: April 2016

Level: Advanced

Time Allowed: 1 hour 15 min

Total: 50 marks

Directions to Candidates:

- Show all your working.
- Write down units where appropriate.
- Use of a scientific calculator is permitted.
- Organise information clearly.
- Use good English.
- Mark allocations are shown in brackets.

Name : _____

Surname : _____

ID Number: _____

Group : _____

Question 1

This question is about the use of graphs to analyze experimental data.

David and Marco were asked to investigate the oscillations of the particular pendulum using the setup shown in Figure 1. The pendulum consists of a loop of string of length L threaded through a nut and then passed over two supports separated by a distance d. The nut acts as a pendulum bob.

The pendulum oscillates in a direction perpendicular to the plane of the loop.

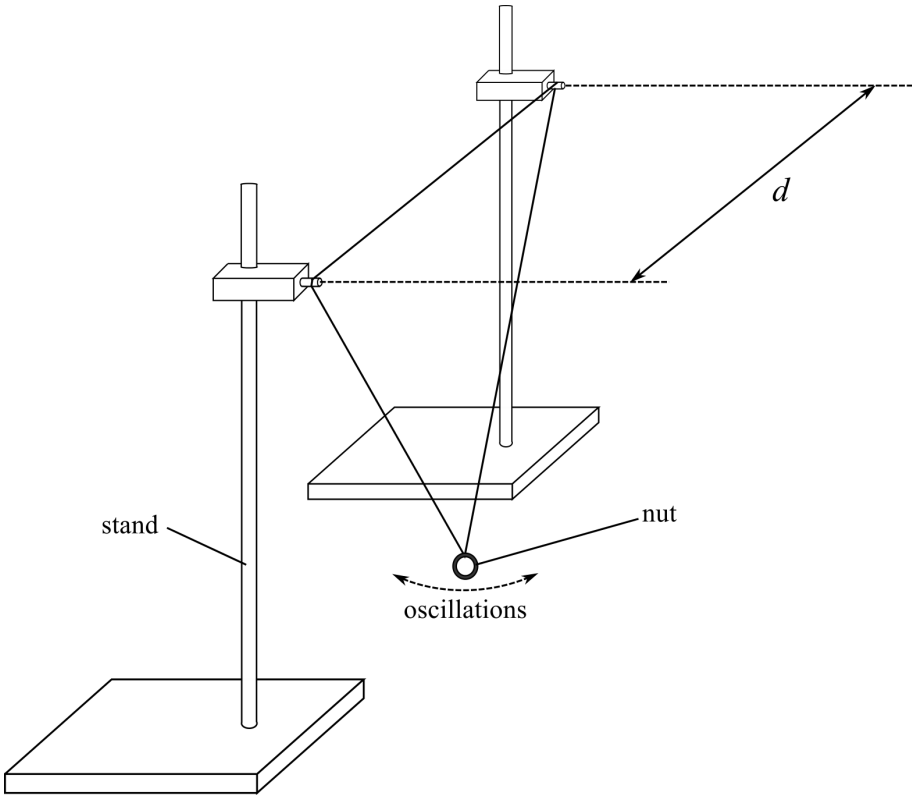

Figure 1

The equation relating the periodic time T of the pendulum and the distance d is given by

$$T^4 = \frac{\alpha}{g^2}K - \frac{\beta}{g^2}d$$

where g is the acceleration due to gravity and K, α and β are constants.

The constant $\alpha = 4\pi^4$ and the constant $K = L^2$.

The distance d was varied by moving the stands and measured using a meter rule. *The smallest division on the metre rule is* 1 mm. David and Marco agreed to measure the time T_{20} taken by the pendulum to go through 20 complete oscillations instead of measuring the periodic time T directly. As an additional precaution, they measured T_{20} twice for every value of d.

All the measurements were recorded and the results are shown in the table below.

d / m	T'_{20} / s	T''_{20} / s	$\overline{T_{20}}$ / s	T / s	T^4 / s^4
±	±	±			
0.150	29.2	29.4	29.30	1.47	4.61
0.300	27.3	27.4			
0.450	24.9	24.7			
0.600	21.1	21.2			
0.750	12.5	12.3			

(a) In the table above, write down the estimate of the uncertainty in the direct measurements.

(2, 2)

(b) Complete the table by filling in the missing values.

(5, 2)

(c) Plot a graph of T^4/s^4 on the y-axis against d/m on the x-axis and draw a straight line that best fits the data.

(6, 2)

(d) Find the gradient of the graph and state its units. (On the graph paper, clearly label the points used to calculate the gradient using the letters **A** and **B** and write down their coordinates adjacent to them.)

(3, 2, 2)

(e) Use your graph to determine the y-intercept. State its units.

(2, 2)

(f) Use your graph to find the value of the constant β and state its units.
(Take the acceleration due to gravity g as 10 m s^{-2}.)

(3,2)

(g) Find a value for the constant K and hence calculate the length L of the string.
(Take the acceleration due to gravity g as 10 m s^{-2}.)

(3, 2)

Question 2

This question is about the use of the Vernier calipers.

A Vernier calipers is used to measure the diameter of a brass cylinder. Figure 2 shows the position of the Vernier scale relative to the mm-scale.

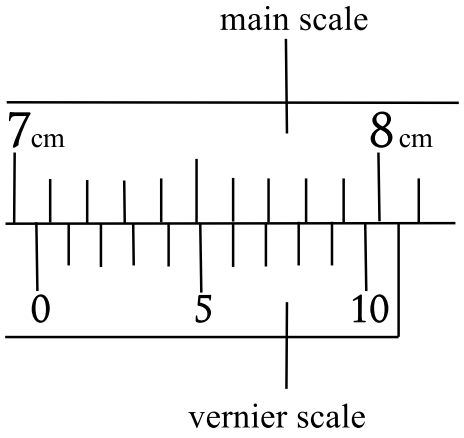

Figure 2

(a) Write down the measurement (in cm) and the corresponding uncertainty (in cm).

Measurement in cm:

_____

Uncertainty in cm:

_____

(2, 1)

(b) List two precautions you would take in order to obtain a reliable value for the diameter of the brass cylinder.

_____

_____

_____

_____

_____

(1, 1)

Question 3

This question is about the use of the micrometer screw gauge.

A micrometer screw gauge is being used to measure the diameter of a wire.

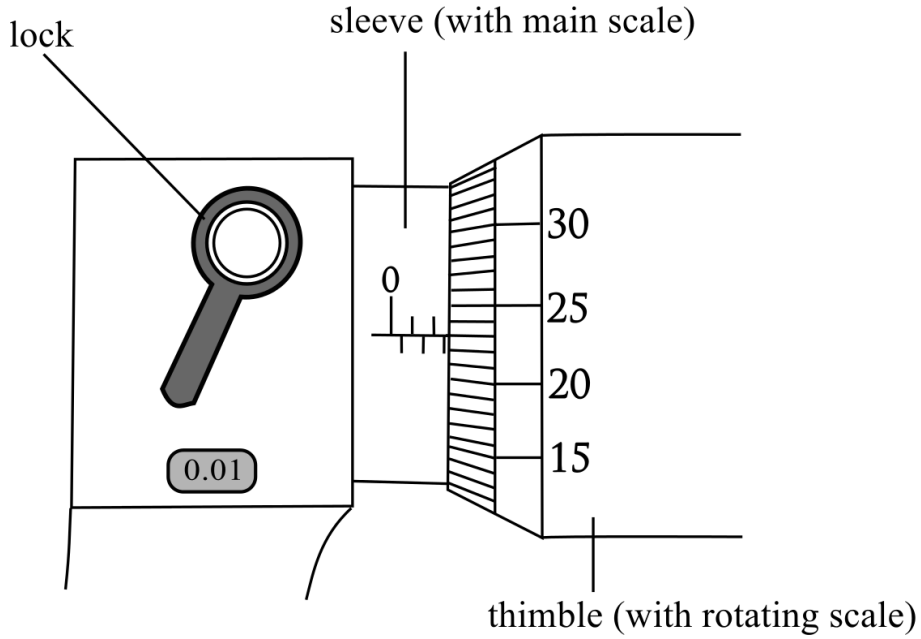

Figure 3

(a) Write down the measurement (in mm) and the corresponding uncertainty (in mm).

Measurement in mm:

_____

Uncertainty in mm:

_____

(2, 1)

(b)Write down a precaution concerning the use of a micrometer screw gauge which must be taken in order to ensure that no excessive forces are applied on the wire?

_____

_____

_____

(2)